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# *Indian Standard*

# COMMENTARY ON INDIAN STANDARD SCHEDULES FOR WROUGHT STEELS

## PART 3 CARBON AND CARBON MANGANESE FREE CUTTING STEELS

**[ Complementary to IS : 1570 ( Part 3 )-1979 ]**

## *( First Revision )*

UDC 669·14·028·232 ( 083·4 )+ 669·15'74-194 ( 083·4 )

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**BUREAU OF INDIAN STANDARDS**
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

# *Indian Standard*

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## [ Complementary to IS : 1570 ( Part 3 )-1979 ]

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# *Indian Standard*

# COMMENTARY ON INDIAN STANDARD SCHEDULES FOR WROUGHT STEELS

## PART 3 CARBON AND CARBON MANGANESE FREE CUTTING STEELS

**[ Complementary to IS : 1570 ( Part 3 )-1979 ]**

## *( First Revision )*

## 0. FOREWORD

**0.1** This Indian Standard ( Part 3 ) ( First Revision ) was adopted by the Bureau of Indian Standards on 25 June 1987, after the draft finalized by the Alloy Steels and Special Steels Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** 'Commentary on Indian Standard wrought steels for general engineering purposes ( IS : 1871 )' was first published in 1965 as complementary to IS : 1570-1961*.

**0.3** With the revision of IS : 1570 into different parts it was felt necessary to revise IS : 1871.

**0.4** The following major modifications have been made in this revision:

a) Steel designations have been modified in accordance with IS : 1762 ( Part 1 )-1974†. However, for the sake of easy identification old designations are also given within brackets.

b) The various grades deleted or added in the revision of IS : 1570 ( Part 3 )-1979‡ have been taken care of.

**0.5** This Part 3 covers carbon and carbon manganese free cutting steels.

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*Schedules for wrought steels for general engineering purposes.

†Code for designation of steels: Part 1 Based on letter symbols ( *first revision* ).

‡Schedules for wrought steels for general engineering purposes: Part 3 Carbon and carbon manganese free cutting steels.

**0.6** Other parts in this series are as follows:

a) Steels specified by tensile and/or yield properties.

b) Carbon steels ( unalloyed steels ).

c) Alloy steels ( including carbon steels for hardening and tempering and case hardening ).

d) High alloy steels and stainless and heat resisting steels including valve steels.

e) Carbon and alloy tool steels.

f) Creep resisting steels.

**0.7** Free cutting steels are characterized by properties of good machinability and satisfactory chip break-up. These properties are mainly achieved by the addition of sulphur. Other additions, like lead and selenium are also made either jointly with sulphur or separately to improve the machinability. Machinability is also improved by cold working, but it deteriorates as the carbon content and the level of deoxidation of steel increase. Sulphide inclusions and segregation bands which are bound up with the nature of free cutting steels shall not be deemed as defects in the material. Sulphide morphology control may lead to higher oxygen content and as a result of this slight porosity may be present in the steel.

## 1. SCOPE

**1.1** This commentary ( Part 3 ) covers carbon and carbon manganese free cutting steels.

**1.1.1** Chemical composition of these steels is given in Table 1.

**1.1.2** Typical uses of steels covered here are given in Appendix A.

**2.** Although cold drawing of low carbon steel improves its surface finish on machining by reducing the tendency to drag and tear, the addition of sulphur enhances its machinability markedly and makes the steel free cutting. This may result in some sacrifice of cold forming properties, weldability and forming characteristics. The applications of these steels are similar to those of carbon steels with similar carbon and manganese contents but they are specifically intended where easy machining is the primary requirement.

**2.1** The addition of lead usually in the range of 0·10 to 0·35 percent can be done to all carbon and resulphurized grades. Lower amounts can be added during teeming without any harmful effects. Selenium and tellurium are also added in combination with lead and sulphur generally up to 0·04 percent. Their additions produce globular sulphides and improve the mechanical properties, selenium is more effective in case of alloy steels. However, these additions increase the cost of steel and are justified in case of heavy machining. Such steels are not included in IS : 1570 ( Part 3 )-1979*.

### TABLE 1 SPECIFIED CHEMICAL COMPOSITION FOR THE STANDARD STEELS

( *Clause* 1.1.1 )

| DESIGNATION | | C PERCENT | Si PERCENT | Mn PERCENT | S PERCENT | P PERCENT |
|---|---|---|---|---|---|---|
| New | Old | | | | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 10C8S10 | ( 10S11 ) | 0·15 *Max* | 0·05-0·30 | 0·60-0·90 | 0·08-0·13 | 0·060 *Max* |
| 14C14S14 | ( 14Mn1S14 ) | 0·10-0·18 | 0·05-0·30 | 1·20-1·50 | 0·10-0·18 | 0·060 *Max* |
| 25C12S14 | ( 25Mn1S14 ) | 0·20-0·30 | 0·25 *Max* | 1·00-1·50 | 0·10-0·18 | 0·060 *Max* |
| 40C10S18 | ( 40S18 ) | 0·35-0·45 | 0·25 *Max* | 0·80-1·20 | 0·14-0·22 | 0·060 *Max* |
| 11C10S25 | ( 13S25 ) | 0·08-0·15 | 0·25 *Max* | 0·80-1·20 | 0·20-0·30 | 0·060 *Max* |
| 40C15S12 | ( 40Mn2S12 ) | 0·35-0·45 | 0·25 *Max* | 1·30-1·70 | 0·08-0·15 | 0·060 *Max* |

NOTE 1 — The steel may be supplied in killed or semi-killed type. In case of killed steel, minimum silicon level should be 0·10 percent.

NOTE 2 — When required lead and other elements are specified as added elements.

**2.2** Steels specified in Table 1 may be obtained either in the hot rolled or cold drawn condition, but cold drawing gives a better finish. Hot rolled steels may be normalised to obtain uniformity in properties. In the case of cold drawn steels, stress relieving at temperature below 620°C may be employed, in order to minimize the variation in hardness and to obtain uniform properties. The normalized or cold drawn steels may also be used for parts which are finally required in case hardened or hardened and tempered condition. Steels 10C8S11, 14C14S14, and 11C10S25 may be case hardened, steels 40C10S18 and 40C15S12 hardened and tempered. These steels are commonly used in the bright condition.

**2.3** Steels 10C8S11, 14C14S14, 11C10S25 and 25C12S14 are used where a combination of good machinability and uniform response to heat treatment is needed. The low carbon variety 10C8S11 is used for small parts which are to be cyanided or carbonitrided. Steels 10C14S14 and 11C10S25 carry more manganese, permitting oil quenching during case hardening treatment. High carbon steels 25C12S14 provides more core hardness when this is needed. It is normally intended for the production of small parts by rapid machining, such as nuts. In case of steels 14C14S14 and 25C12S14 it may be an advantage to stress relieve the bars.

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*Schedules for wrought steels for general engineering purposes: Part 3 Carbon and carbon manganese free cutting steels.

**2.4** Steels 40C10S18, and 40C15S12 have characteristics comparable to carbon steels of the same carbon level and are preferred where large amount of machining is necessary, or where threads, spline or other operations offer tooling problems. They may be obtained as hot rolled, normalized or cold drawn. These steels may be hardened and tempered to increase strength and are usually suitable for oil quenching. The high manganese variety steel 40C15S12 offers greater hardenability.

**2.5** For the guidance of users, machinability ratings for various steels in the cold drawn condition are given in Table 2. These ratings are based on a value of 100 percent for steel 11C10S25 in the cold drawn condition. This value involves turning at a cutting speed of 54·9 surface metres ( or 180 surface feet ) per minute for feeds up to 0·177 8 mm ( or 0·007 in ) per revolution and depths cut up to 6·35 mm ( or 0·250 in ) using appropriate cutting fluids with high speed steel ( T70W18Cr4V1 ) tools.

### TABLE 2 MACHINABILITY RATINGS FOR VARIOUS STEELS IN THE COLD DRAWN CONDITION

| Sl No. | Indian Standard Steel | Type of Processing | Brinell Hardness HB | Average Machinability Rating ( Cold Drawn 11C10S25, 100 Percent ) |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| i) | 10C8S10 | Hot rolled | 101 | — |
| | | Cold drawn | 121 | 80 |
| ii) | 14C14S14 | Hot rolled | 121 | — |
| | | Cold drawn | 137 | 90 |
| iii) | 25C12S14 | Hot rolled | 126 | — |
| | | Cold drawn | 143 | 80 |
| iv) | 40C10S18 | Hot rolled | 179 | — |
| | | Cold drawn | 197 | 70 |
| v) | 11C10S25 | Hot rolled | 121 | — |
| | | Cold drawn | 137 | 100 |
| vi) | 40C15S12 | Hot rolled | 187 | — |
| | | Cold drawn | 212 | 70 |

# APPENDIX A

( *Clause* 1.1.1 )

## A-1. CARBON AND CARBON-MANGANESE FREE CUTTING STEELS

| *Steel Designation* | *Typical Uses* |
|---|---|
| 10C8S10 | Used for small parts to be cyanided or carbonitrided. |
| 14C14S14 | Used for parts where good machinability and finish are important, and where disadvantages of the higher sulphur required to give full free cutting properties make the use of the more rapid machining steel 11C10S25 undesirable. Transverse properties are better than those of steel 11C10S25 but not as good as those of the normal low sulphur steels. |
| 25C12S14 | Bolts, studs and other heat treated parts of small section. Suitable in either cold drawn, normalized or heat treated condition for moderately stressed parts requiring more strength than that of mild steel. |
| 40C10S18 | Heat treated bolts, engine shafts, connecting rods, miscellaneous gun carriage, and small arms parts not subjected to high stresses and severe wear. Owing to its low hardenability its use in the hardened and tempered condition is not recommended for large masses. |
| 11C10S25 | Used for lightly stressed components not subjected to shock ( nuts, studs, etc ) and suitable for production on automatic lathes. This is not recommended for general case hardening work but should be used when ease of machining is the deciding factor. It is not intended for use where the hardened case is subjected to severe impact in service. |
| 40C15S12 | Heat treated axles, shafts, small crankshafts and other vehicle parts. It is not recommended for forgings in which transverse properties are important. |

( *Continued from page* 2 )

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